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SILO AND MILL CONSTRUCTION IN THE USSR

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/Diagrams referred to herein are not reproduced/

Both private concerns and the state were contractors in prewar silo construction. Grain silos with a large cubical content were built, but their mechanical equipment had a relatively low performance capacity.

The silo industry of that period could not serve as the basis for the development of a progressive grain industry and it could not serve as a technical apparatus to operate the grain trade as the grain elevator system does in North America.

The Revolution, which radically transformed our country's national economy, brought an entirely new development tempo to grain production in the USSR and to the related grain storage.

The "Soyuz Khleb" corporation, exclusive authority on grain production and storage of the national grain reserves, and director of almost the entire grain-milling industry of the country was faced with the necessity of creating an extensive grain-elevator system. The fundamental prerequisite for a silo construction system is the erection of local silos intended to secure the grain directly from the producer, that is, from the farmer, the kolkhos (collective farms), the sovkhos (state farms), and to load it onto the transport medium which is to carry it to its destination.

After years of research "Soyuz Khleb" succeeded in developing a series of types of such silos with adequate cubical content and the required performance capacity. These silos conform to the demands of the national grain-economy policy and have found wide-spread use. In the past five years over 200 such silos with a total space for more than 330,000 tons of grains were built in various regions of the USSR. In

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1928 the "Soyuz Khleb" corporation intends to accelerate still more the tempo of mill and grain-elevator construction. In addition, cooperatives and national grain-export organizations will erect large silo structures (harbor grain elevators).

Such an upswing in the grain elevator construction system calls for elevators that are structurally simple and very cheap. This was achieved, by employing to a great extent, the newest type of American board structures fastened with nails.

The normal period of time required to construct and equip such a grain elevator - computed from the moment of organization of the work to the day when it is ready to start operations - amounts to 100 days. This permits starting the construction of each grain elevator in the spring and finishing it at the beginning of the grain season. The capacity of these elevators makes up to 20 turnovers possible, depending upon the results of the harvest; that is, if an elevator has a capacity of 1,600 tons per day, up to 32,000 tons can be processed.

The construction of the wooden type of grain elevator, which is still being intensively carried out, represented the first step in the development of the grain elevator construction system of the Soviet Union (Diagram 1). The grain industry of the USSR, developing successfully since 1926, took upon itself the task of constructing profitable, fireproof grain elevators.

Ferroconcrete grain elevators built in the prewar period did not prove to be profitable. Wastefulness in construction and a long construction period led to a high cost. The "Soyuz Khleb" corporation was confronted with the task of working out types and structures for ferroconcrete grain elevators that could compete in cost with wooden grain elevators.

It was necessary to construct mill and terminal elevators with the tremendous capacity of 3,500 to 32,000 tons in addition to constructing ferroconcrete grain elevators with local significance.

In this respect the "Soyuz Khleb" corporation was influenced by the extensive experience of North America which had had great success in building ferroconcrete silos. Economic necessity had forced the Americans to work out the simplest type of elevator plans and to discover simple and inexpensive methods of carrying out the ferroconcrete work. One of these processes was the slide-form method for the ferroconcrete work.

The slide-form process had not yet been employed in European architecture and was first used in the USSR in 1926 by the "Soyuz Khleb" corporation for the erecting of a grain elevator in the North Caucasus. At present it is used extensively in grain-elevator and mill construction in the USSR.

The slide-form process is as follows: 1.20-meter-high forms, manufactured for the concrete, are fastened together by special clamps (supports) to form a structural unit. These forms are hoisted by screw spindles (jacks), resting on metal bars sunk in concrete, according to the progress in the concrete work and the height of the building.

Such a working method reduces wood consumption and labor in the manufacture of forms (since the form, once it is manufactured, slides to the top of the building). It also permits a speedy forward movement of the forms which actually move without interruption. This means that the concrete work proceeds without interruption and that the construction period is restricted to a minimum.

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It seems as if such a quick removal of concrete from the f[redacted] would necessitate the use of cement which hardens with exceptional speed; unfortunately European builders are also of the same opinion. (See article by Engineer F. Mellor, Darmstadt, Germany, in the periodical Stroitelnaya Promyshlenost, No 10, October 1929, Moskva). The "Soyuz Khleb" corporation erected up to 30 large buildings by the use of slide forms and it based its work on laboratory tests (test cubes) made shortly after mixing the concrete. Its experience indicates that when quite ordinary portland cement manufactured in USSR factories is used, the forms can be moved forward as much as 3 metersdaily (24 hours) in summer without detrimental effects on the strength of the cement and without danger of damaging the concrete during the work.

Not only the actual silo buildings of the elevator installation but quite a number of multiple-storied frame constructions were built by the use of slide forms, for example, grain elevator work buildings, various mill departments, and a number of buildings with numerous vertical walls, such as unloading towers, supports under conveyor bridges, water towers, etc. (Diagrams 6, 7, 8, and 9)

In addition to the indicated advantages, the use of slide forms makes it possible to carry out ferroconcrete work also during the cold season. Simple canvas curtains which move along with the forms are used and special heaters attached to the forms produce a layer of warm air about the concrete being worked (Diagram 10). (Compare also "Dedication of the Ferroconcrete Superstructure Co" in Volume 2, of the current year. Editorial Staff) [German Editorial Staff.]

The nature of the demands put upon structures to be erected by slide forms is given serious consideration in the planning of these buildings. Greater care is taken to estimate every work process and every structural part from the standpoint of simplicity and cheapness of execution in the case of planning slide-form buildings than in planning ordinary-form buildings.

This conception which, in the long run, aims at a decrease in building costs, has changed the character of the buildings in many respects.

The walls of a grain silo may serve as an example of a structure particularly adapted to slide-form construction. These are erected directly from the foundation and make unnecessary the costly construction of supporting pedestals with columns, supporting rings, and suspended hopper. The silo hoppers are made only after the concreting of the silo walls, which saves both time and money. There are hoppers in frequent use which, when arranged near the surface of the ground, are backed with sand or earth heaped directly on the ground. In other cases this backing is made of a light, poor slag concrete fixed on a flat ferroconcrete plate hung to the silo walls.

Of course, the slide-form method alone could not have resulted in any great decrease in building costs. A corresponding mechanization of construction was required. "Soyuz Khleb" was not seeking a record performance in construction speed. Rather it strove, in erecting the buildings, to maintain a tempo at which the mechanization of the concrete work proved to be most profitable. Work carried out in this line indicated that a 3 meters forward move of the forms every 24 hours is completely adequate even for small buildings with simple contours. If the forms are moved at a greater speed and quick-hardening cement is used, a correspondingly intensified mechanization will be required. The effect achieved by this speed would not compensate for the cost.

Thus, our experiences have not adequately confirmed the opinion existing at present in Europe that quickly hardening, high-grade cements are required for slide-form construction.

The use of slide forms in the ferroconcrete construction of the "Soyuz Khleb" is only one phase in the rational mechanization of building processes. No less attention is devoted to planning the most advantageous concrete composition. In this connection all published data on the matter by the American Portland Cement Association was used.

The production of strong concrete with a minimum cement consumption was made possible by the consideration of the cement quality in each individual case, the choice of water-to-cement ratio in order to predetermine the strength of the cement mixture, gradation of grain size in the mass of stone admixture according to the modulus of fineness, and a further systematic treatment of the concrete.

The task was set of properly determining concrete ingredients in accordance with the strength computation, and of establishing the consistency which prevents the flow of mixture from the forms and at the same time guarantees the plasticity of the concrete required for the work. Success was achieved in determining that the most economical concrete is not cast concrete but a plastic concrete which, according to wall strength and air temperature has the settling measurement of the Abram's cone, 8-12 centimeter.

It is understood that such treatment of cement required: (1) strict check of concrete composition in the building site laboratories; (2) continual checking of prepared concrete by cube testing in laboratories; (3) establishment of definite standards for the durability of the concrete mixture.

In this way two factors, (1) the planning of the profitable mechanization of construction work, and (2) the scientific attitude in determining concrete ingredients, helped towards the successful development and lowered cost of the building of ferroconcrete grain elevators and mills in the USSR.

We hope that a parallel development of such ferroconcrete buildings in Germany will furnish us with many new examples leading to a mutual exchange of experiences.

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